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## Algal documentation and Phytochemical studies of red algae *Gracilaria corticata* of Manapad Coast, Tamil Nadu

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**ABSTRACT**

Algal source from Manapad coast, Tamil Nadu was surveyed during summer 2013 and documented in the form of herbaria. About 51% members were recorded from Rhodophyceae followed by 27% of Phaeophyceae and 22% of Chlorophyceae respectively. Internal anatomy of *Gracilaria corticata* was studied under electron microscopic (SEM) analysis with reference to thallus cell wall, elemental composition by EDAX and IR - spectral analysis (FTIR) were studied. Phytochemical screening was carried out by *G. corticata*, by cooling percolation extraction; using different solvents like methanol, ethanol, petroleum ether and acetone. The present study revealed that most of the bioactive components like alkaloids, catechin, flavonoids, phenol, quinones, steroids, tannins, glycosides, amino acid, sugar and xanthoprotein were present in all the extracts of *G. corticata*.

**Keywords:** *Gracilaria corticata*, SEM-EDAX, FT-IR, Bioactivity

**1. Introduction**

Seaweeds are the primitive angiosperm that has incomparable mineral source particularly marine red and brown algae. They are used as commercial products; stabilizers, thickeners, emulsifiers, foods etc. In recent years, phycologists focus the bioactive substances of marine plants because of the presence of macro and trace elements and their cell wall composition. Several red algae contains agar as water soluble sulfated galactan located in the intercellular spaces. Agar is a mixture of polysaccharide, which can be composed of agarose and agaropectin with similar structural and functional properties as carrageenan of red algae. Agar is used in manufacture of capsules for medicinal applications. The importance of seaweed products in pharmacology is known, the development of antibacterial, antifungal and antiviral substances from seaweeds is still in the growing stage of research and development. The present research work deals with the documentation of algae from the study area, internal anatomy, elemental composition, spectral analysis and phytochemical screening of red algae *G. corticata* of Manapad coast, Tamil Nadu. Coralline red agarophytic alga *G. corticata* present in most of the seasons of this study area are reported previously<sup>[3]</sup>.

**2. Materials and methods**

Seaweeds were collected from Manapad coast of Tamil Nadu, India (8.3775°N; 78.0522°E) during summer 2013 (from April to July) at low tide. Specimen was washed thoroughly in seawater to remove extraneous matter such as epiphytes, sand, shell and brought to the laboratory in polythene bags for further studies. *G. corticata* of red agar yielding algae was used for preliminary phytochemical analysis under laboratory condition. The specimen was thoroughly washed with fresh water, blotted and weighed. Then they were shade dried and powdered to 40 µm mesh size. The active compounds in the powdered sample were extracted using organic solvents like acetone, petroleum ether, methanol and ethanol by cooling method. The powder was soaked in respective solvents for 48 hours and this procedure was repeated when the sample decolorized for thrice. All extracts were done at room temperature and evaporated for further phytochemical screening.

The specimen was sectioned and studied under Scanning Electron Microscope (SEM) and EDAX- ray microanalysis. For SEM analysis, 3 mm size of specimen fixed in 3% glutaraldehyde and 0.1 ml of phosphate buffer. After fixation, the specimen was dehydrated through a graded series of alcohol for 5 minutes in each. The dehydrated sectioned specimen examined under TESCAN-VEGA3-LMU-USA instrument with EDAX. The weight of the elements and their atomic weight (in %) were estimated. Infrared spectrum was taken for the dried plant sample using FT-IR (Perkin Elmer) instrument. Finely powdered sample about 1mg was mixed with about 100 mg of dried potassium bromide (IR grade) powder.

### 2.1. Preparation of extracts

Dried specimen of *G. corticata* was weighed and chopped. Sample

was pulverized using mortar and pestle. The sample weighed 1 gm was taken and extracted using different solvents at room temperature. The extract was concentrated, collected and subjected for phytochemical screening. Qualitative phytochemical analysis of different extracts like methanol, ethanol, petroleum ether and acetone were subjected to qualitative tests for the identification of various phytochemical constituents as per standard procedures<sup>[4, 7, 8, 9]</sup>.

### 3. Results and Discussion

During summer 2013 (from April to July) seaweeds collected from Manapad coastal area of Tamil Nadu, India are documented in Table – 1. Collected seaweeds are preserved in the form of herbaria.

**Table 1:** Documentation of macroalgae from Manapad coast, Tamil Nadu, India

S. No	Herbarium No.	Name of the algae	Months			
			April	May	June	July
<b>CHLOROPHYCEAE</b>						
1.	ACBHC01	<i>Chaetomorpha antennina</i> (Bory) Kuetz.	+	+	-	+
2.	ACBHC02	<i>Caulerpa sertularioides</i> (Gmel)	+	+	-	+
3.	ACBHC03	<i>C. scalpelliformis</i> Dwarka	+	+	-	+
4.	ACBHC04	<i>C. taxifolia</i> (Vahl.) Ag.	-	-	-	+
5.	ACBHC05	<i>C. racemosa</i> (Forssk.)	+	+	-	+
6.	ACBHC06	<i>Enteromorpha compressa</i> (Linn.)	+	+	+	+
7.	ACBHC08	<i>Halimeda macroloba</i> Decaisne	+	+	-	+
8.	ACBHC10	<i>Ulva lactuca</i> (Linn.)	+	+	+	+
9.	ACBHC11	<i>U. reticulata</i> (Forssk.)	+	+	+	+
<b>PHAEOPHYCEAE</b>						
10.	ACBHP13	<i>Sargassum wightii</i> Greville	+	+	-	+
11.	ACBHP14	<i>Sargassum aquifolium</i> (Turn.) C. Ag.	+	+	-	-
12.	ACBHP17	<i>Stoechospermum marginatum</i> (Ag.) Kuetz.	-	-	+	+
13.	ACBHP19	<i>Padina tetrastromatica</i> Hauck.	+	-	+	-
14.	ACBHP20	<i>P. gymnospora</i> (Kuetz.)	-	-	+	+
15.	ACBHP21	<i>Pocokiella variegata</i> (Lamour.)	+	-	-	+
16.	ACBHP22	<i>Spatoglossum asperum</i> J. Ag.	+	-	-	-
17.	ACBHP23	<i>Dictyota dichotoma</i> (Huds.) Lamour.	-	-	+	+
18.	ACBHP24	<i>Turbinaria conoides</i> Kuetz.	+	-	+	+
19.	ACBHP25	<i>T. decurrens</i> Bory	+	+	-	+
20.	ACBHP26	<i>T. ornate</i> J. Ag.	-	-	-	+
<b>RHODOPHYCEAE</b>						
21.	ACBHR27	<i>Ceramium miniatum</i> Suhr.	+	-	-	-
22.	ACBHR28	<i>Gracilaria edulis</i> (Gmel.)	+	+	-	-
23.	ACBHR29	<i>G. corticata</i> J. Ag.	+	+	+	+
24.	ACBHR30	<i>G. crassa</i> Harvey	+	-	-	+
25.	ACBHR31	<i>G. verrucosa</i> (Hunds)	+	-	-	-
26.	ACBHR32	<i>G. folifera</i> (Forssk.)	+	-	+	+
27.	ACBHR33	<i>G. fergusonii</i> J. Ag.	+	-	+	+
28.	ACBHR34	<i>Laurencia obtusa</i> (Huds.) Lamour.	+	-	+	+
29.	ACBHR35	<i>Laurencia papillosa</i> (Forssk.) Greville	+	-	+	+
30.	ACBHR36	<i>Cryptonemia undulate</i> Sonder	+	-	+	+
31.	ACBHR37	<i>Hypnea valentiae</i> (Turn.) Mont.	-	+	+	+
32.	ACBHR38	<i>H. musciformis</i> (Wuif.) Lamour.	+	-	-	+
33.	ACBHR39	<i>Gelidiopsis ripens</i> (Kuetz.) Schmitz	-	-	-	+
34.	ACBHR40	<i>Gelidium pusillum</i> (Stackh.)	-	-	+	+
35.	ACBHR41	<i>Amphora dilatata</i> Lamouroux	-	-	-	+
36.	ACBHR42	<i>Agardhiella subulata</i> Schmitz	+	+	+	-
37.	ACBHR43	<i>Sarconema filiforme</i> (Sond.)	+	+	-	+
38.	ACBHR44	<i>Grateloupia filicina</i> (Wulf.) Ag.	+	-	+	+
39.	ACBHR45	<i>Jania adherens</i> Lamour	+	-	+	+
40.	ACBHR46	<i>Enantiocladia prolifera</i> (Grev.) Falkenb.	+	+	-	-
41.	ACBHR47	<i>Acanthophora spicifera</i> (Vahl.) Borgesen.	+	+	+	-

(+) = Presence (-) = Absence

About the collected seaweeds 51% were Rhodophyceae members followed by 27% of Phaeophyceae and 22% of Chlorophyceae members respectively. Most of the algae were available at Manapad for all the study period which is indicative of the marine

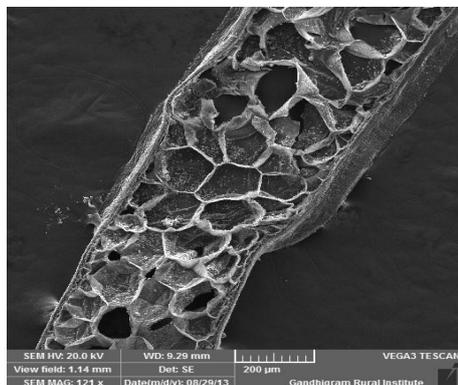
environment of this station capable of supporting seaweeds species. During the study periods, day hours is long so that the sunshine is one of the reasons for rich algal vegetation and also the presence of physical and chemical properties of seawater. Maximum number of

algae was observed in the month of April and July 2013. Phytochemical analysis of *G. corticata* is presented in Table – 2. Most of the bioactive compounds like alkaloids, catechin, flavonoids, phenol, quinones, steroids, tannins, glycosides, amino acid, sugar and xanthoprotein are found. Whereas, compounds like anthraquinone, saponin and fixed oil are not found. Algae are a natural source of bioactive molecules with a broad range of biological activities, such as antibiotics, antivirals, antitumorals,

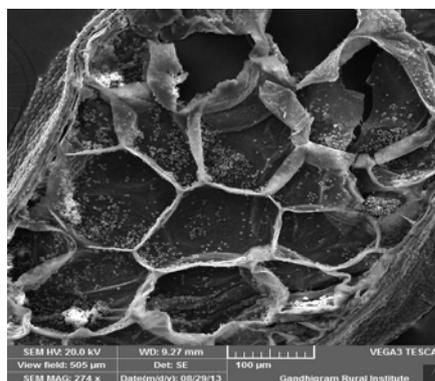
antioxidants and anti-inflammatories [2]. A large number of algal extract products have been found to have antimicrobial activity [11, 12].

The thallus structure and cell wall organization of *G. corticata* was studied using Scanning Electron microscope (SEM). Photograph of SEM (Plate – 1) showed the cell structure as well as intercellular matrix polysaccharide.

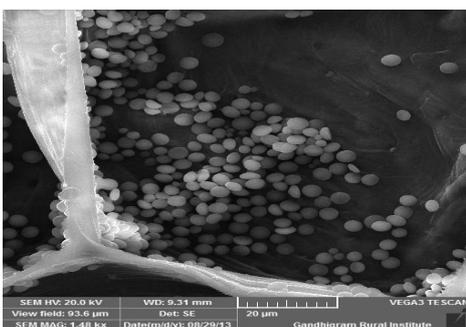
#### PLATE - 1



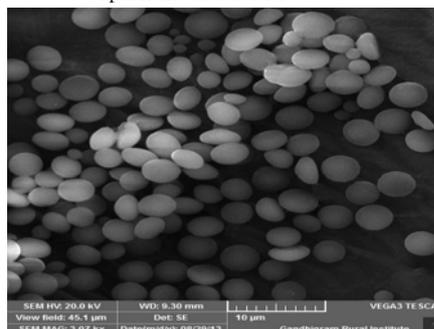
A. SEM - photograph of *G. corticata* thallus



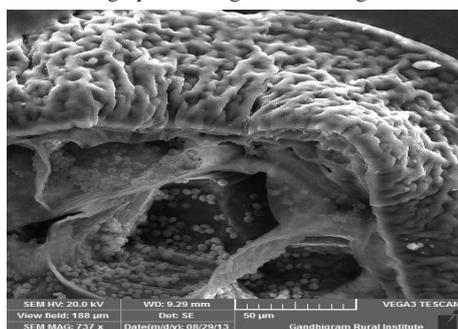
B. Higher magnification showing epidermis and cortex



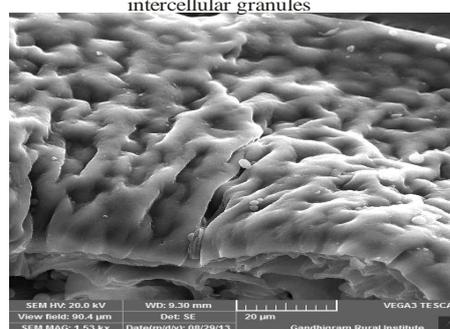
C. Photograph showing intercellular granules



D. Higher magnification showing intercellular granules



E. Photograph showing cell wall of *G. corticata* thallus



F. Higher magnification showing cell wall polysaccharide

Seaweed polysaccharides are differentiated than other plants. The agarophyte of red *G. corticata* contain unique sulfated galactons that are nutraceutical and pharmaceutical important. In higher magnification (Plate -1 B, D, E) showed the intercellular granules and the thickness of cell wall polysaccharide of agarophytic algae. Morphological and anatomical study of marine seaweeds have been carried out by some workers at different places using SEM and X- ray microanalysis (EDAX)[5, 6, 15]. Table - 3 and figure 1 showed that the trace elements of *G. corticata* contain eight elements in the following order; C>O>S>Mg>Na>Ca>Si>K. About the eight elements, the maximum contribution is carbon in the thallus was 51.26% and least amount (0.02%) of potassium was recorded. Contribution of other elements like oxide (46.75%),

sulphur (0.87%), magnesium (0.38%), sodium (0.25%), calcium (0.39%), silica (0.07%) are respectively present in the thallus. Some of the important trace elements like calcium, silicon, sodium and magnesium are present at low level are a significant of this study. Inorganic substances like S, Ca, Mg, Si, Na, K are essential for daily functions and defense of human system. Minerals cure body ailments and make energy for cells, bone strength and cell organelles functions. So trace elements balance the living system for biochemical and nutritional aspects.

IR spectra of *G. corticata* powder exhibited sharp peaks at 617  $\text{cm}^{-1}$  and 1459  $\text{cm}^{-1}$  for organic compounds, a broad band in the range of 1116  $\text{cm}^{-1}$  and 3334  $\text{cm}^{-1}$  for phenol group and peaks at 1651  $\text{cm}^{-1}$  for amine group (Fig. 2). The presence of methyl groups,

sulfate and pyruvate branches such as xylose or 4-*O*-methyl-L-galactose residues were also reported in the agar of *Gracilaria* species [14]. IR spectroscopy has been effectively used to characterize algal polysaccharides [1]. Polysaccharides are sulfated

galactans show potent anticoagulant activity which may be due to the various degree of sulphations [10, 13, 16]. On the basis of FTIR spectra, it could be identified and confirmed that bioactive compounds are present in the test sample.

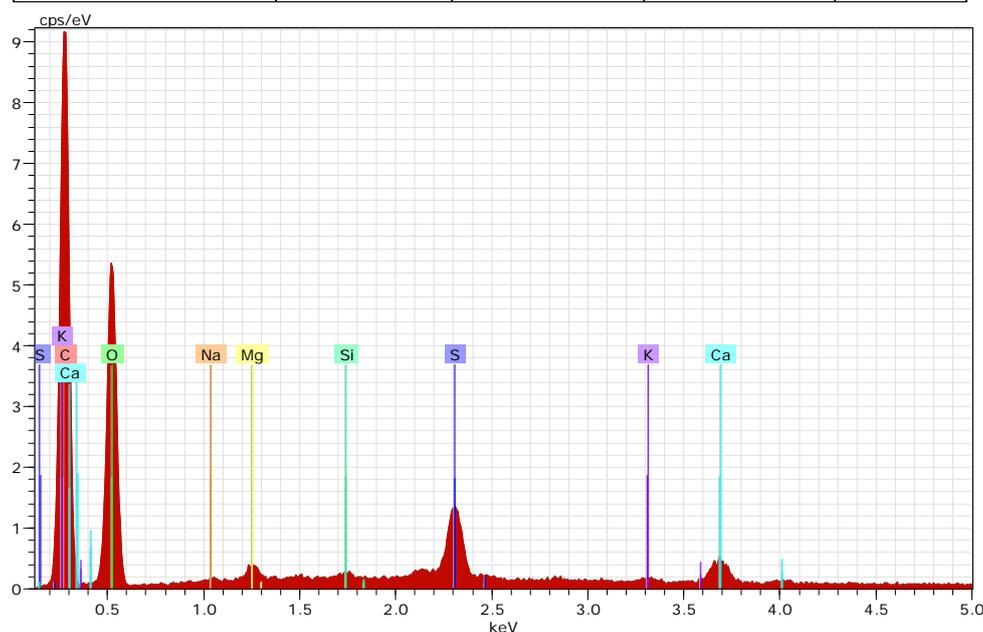
**Table 2:** Phytochemical analysis of *G. corticata* thallus of Manapad Coast, Tamil Nadu, India.

S. N	Tests	Solvents			
		Methanol	Ethanol	Petroleum Ether	Acetone
1.	Alkaloids	+	+	+	+
2.	Anthraquinone	-	-	-	-
3.	Catechin	+	+	-	-
4.	Flavonoids	+	+	-	+
5.	Phenol	+	+	+	+
6.	Quinones	+	+	+	+
7.	Saponin	-	-	-	-
8.	Steroids	+	+	+	+
9.	Tannins	+	-	+	+
10.	Sugar	+	+	-	+
11.	Glycosides	+	+	-	-
12.	Amino acid	+	+	-	-
13.	Xanthoprotein	+	+	-	+
14.	Fixed oil	-	-	-	-

(+) = Presence (-) = Absence

**Table 3:** Shows the chemical elements present in the *Gracilaria corticata* thallus of Manapad coast, Tamil Nadu, India

Element	AN Series	unn. C [wt. %]	Norm. C [wt. %]	Atom. C [wt. %]	Error (1 Sigma)
C 6	K Series	51.26	51.26	58.81	6.39
O 8	K Series	46.75	46.75	40.27	6.11
S 16	K Series	0.87	0.87	0.37	0.06
Mg 12	K Series	0.38	0.38	0.22	0.05
Na 11	K Series	0.25	0.25	0.15	0.05
Ca 20	K Series	0.39	0.39	0.14	0.04
Si 14	K Series	0.07	0.07	0.04	0.03
K 19	K Series	0.02	0.02	0.01	0.03
<b>Total:</b>		<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	



**Fig 1:** X-ray (EDAX) microanalysis of *Gracilaria corticata* thallus of Manapad coast, Tamil Nadu, India

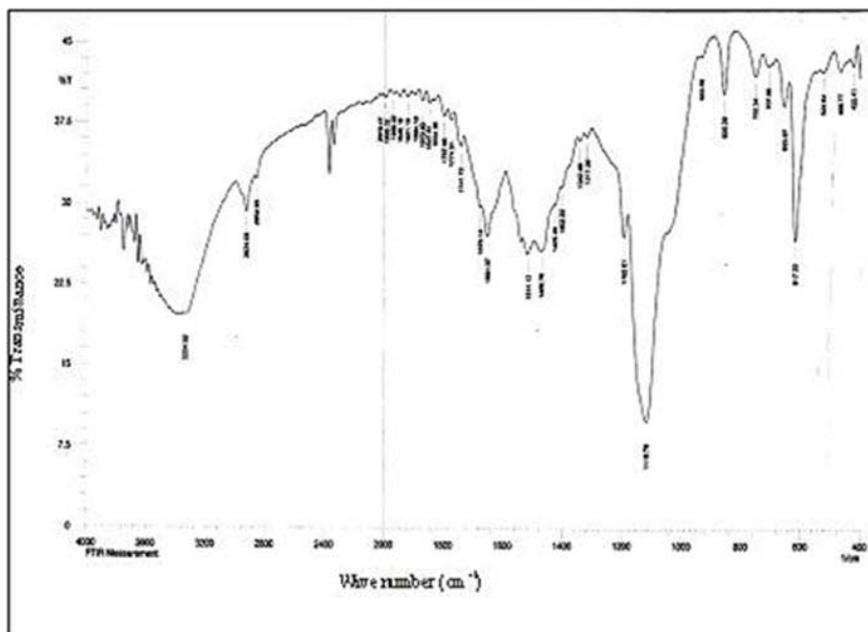


Fig 2: FT-IR spectra of *Gracilaria corticata* thallus of Manapad coast, Tamil Nadu, India

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